Short Resume/Synopsis of Ph.D. Topic

Entitled

"STUDIES ON EFFECTS OF PARASITIC INFECTIONS IN MACKEREL *RASTRELLIGER KANAGURTA* (CUVIER, 1816) OF MUMBAI COAST WITH SPECIAL EMPHASIS ON IMMUNITY, NUTRITION & SURIMI"

Submitted to

THE FACULTY OF SCIENCE & TECHNOLOGY,

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NANDED-431 606 (M.S.), INDIA

For the Degree of

Doctor of Philosophy in Zoology

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March-2022

SHORT RESUME / SYNOPSIS OF PH.D TOPIC

"STUDIES ON EFFECTS OF PARASITIC INFECTIONS IN MACKEREL *RASTRELLIGER KANAGURTA* (CUVIER,1816) OF MUMBAI COAST WITH SPECIAL REFERENCE TO IMMUNITY, NUTRITION & SURIMI."

1. A brief resume of proposed work / problem

Mackerel *Rastrelliger kanagurta* (Cuvier, 1816) (Scombridae), are commonly found fish species along the all the coast of India. Different parasites infecting Mackerel, which include endoparasites, ectoparasites and microbes like bacteria, are planned to be studied for impact of their infection on Mackerel which adversely affect their immunity and nutritional value. Owing to abundance of Mackerel in Mumbai coastal region, this study is planned to be done for hosts occurring in this western region of India. The main aspects of intended work include study of taxonomy, population dynamics with seasonal occurrence, immunology, bacteriological study for effect on their nutritional value having direct impact on Surimi production.

2. Introduction to proposed research topic:

Sea food is great option to include in the diet as it contains high quality of nutrients such as metabolically essential proteins, vitamins, trace elements, polyunsaturated fatty acids and especially important constituent omega 3 fatty acids which are essential fats that human bodies do not produce. Healthy nutrition is also vital when it comes to offering protection from many health problems including chronic diseases. It is recommended to regularly eat sea food for optimal wellness for all physical and mental function of food. Data from studies of large no of people shows that eating sea food reduces respiratory death by 20% and are associated significantly with lower rate mortality. Omega 3 fatty acids an important source of fish meat supports the immune system reduces inflammation and enhances healing processes. It is vital for brain development and brain health. Fish with highest omega level include Salmon, Mackerel, Trout, Sardines, Anchovies etc. Mackerel are abundant in the catch almost throughout the year. It is one of the tastiest, cheapest and yet plentiful marine fish species and hence selected for studies.

Mackerel is an important fishery along the entire coast of India. However, they are not devoid of parasitic attacks. Despite its common occurrence in Indian waters, the parasite fauna has not been subjected to detail study. Three types of fish parasites which are identified are Round worms (Nematodes), flat worms (Trematodes) & tape worm (Cestodes). Madhavi &Triveni, 2012 have reported about 15 species of parasites including Bacteria, Monogenea, Digenea & Crustacean species. Fish parasites were ranging from microscopic Protozoans to visible Crustaceans &Anniellids. (Suresh et al., 2021). Parasite can cause mechanical damage, fusion of gill lamellae & tissue replacement. Physiological damage such as cell proliferation, immunomodulation, detrimental behavioral responses, altered growth and reproductive damage. Hence study of parasite & effects of parasitic infection on nutritive value of fish is undertaken in present investigation.

The Indian mackerel, *Rastrelliger kanagurta* is a species of mackerel in the scombrid family (family Scombridae) of order Perciformes. It is commonly found in the Indian and West Pacific oceans, and their surrounding seas. It is an important food fish and is commonly used in South and South-East Asian cuisine. It is known by various names, such as Pelaling in Malaysia and Indonesia, Bangdo in

Konkani language, Bangdi in Gujarati, Bangda in Marathi, Kajol Gouri in Bengali, Ayla in Malayalam, in Odia, Kaanankeluthi in Tamil and Bangude in Tulu, and Kannada.

Fish is a major source of food to mankind. It provides a significant amount of poly unsaturated fatty acids intake in the diet of a large proportion of people in the developing countries. Along the east coast of India *Rastrelliger kanagurta,* is the most popular fish species used as the food (Lakshman et al., 1999). The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish. The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases. Besides being used as food, fish is also increasingly demanded for use as feed. It is also useful to the ecologists and environmentalists who are interested in determining the effects of changing biological/environmental conditions on the composition, survival, and population changes within fish species. Fish consumption has several nutritional and health benefits which are mainly due to the presence of proteins, unsaturated fatty acids, minerals (calcium, iron, selenium zinc etc) and vitamins including A, B3, B6, B12, E, D. The study of mineral elements present in living organisms is of biological importance; since many of such elements take part in some metabolic processes and are known to be indispensable to all living things. The body usually contains small amount of these minerals, some of which are essential nutrients, been components of many enzymes system and metabolic mechanisms and as such contribute to the growth of the fish. The most important mineral salts are that of calcium, sodium, potassium, phosphorous, iron, chlorine while many others are also needed in trace amounts. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning; as it reduces productivity and causes diseases, such as inability of blood to clot, osteoporosis, anemia etc. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish.

Mackerel is a very important group of commercial fish tanking second in annual tonnage of marine fishes landed. It is in great demand in fresh condition. 60% consumed fresh, remaining preserved. Large percentage (40%) of the catch is preserved in ice and dispatched to inland areas and 60% catch is salt cured or pickled or sun dried or smoked. When the catch is abundant, the surplus is converted into manure which is used for coffee & coconut plantation. The viscera & gills discarded from the curing & canning plants is used in the preparation of fishmeal, Poultry feed, cattle feed & manure. They are of importance not only to India, but also too many countries bordering the Indian ocean & western pacific ocean for which reason several international integrated research projects are sponsored by organization like the indo pacific fisheries council of the FAO. Therefore, considering these parameters, this study aims in the analysis of difference in the nutritive value of male and female Indian mackerel, *Rastrelliger kanagurta,* which is revealed by the measurement of vitamins, some minerals and antioxidants between the two sexes

All living organism including fish are infested with parasites. The knowledge regarding the nutritional significance of fish associated with diseases is relatively scanty. Parasites alter the physiological processes of fish which is evident from the variation found in biochemical parameters of the fish meat. Hence it was decided to study the variations in the biochemical parameters, further infections may be of more frequent occurrence in certain season, thus its necessary to find out seasonal variations in nutrients. Fish meat is an excellent source of wide spectrum of supporting micronutrients like proteins, omega 3 fatty acids, vitamins, zinc and minerals such as iodine, calcium, magnesium, phosphorus, potassium, iron and selenium. So the quantitative estimation of these nutrients is considered desirable.

Surimi production is a technology in which the minced and refined flesh of fish prepared from a variety of lowly valued fish meat which is fish meat utilization technique for longer duration. The Surimi is a refined form of mechanically deboning fish meat that has unique functional characteristic which makes it valuable in broad range of food products. Surimi processed technology involves washing of minced fish for purifying and concentrating muscle proteins which may be further processed into secondary products frozen and stored for later use (K.E Spencer & M A Tung,1994 (in the book " Seafood : Chemistry, Processing & Technology). The fish species which are underutilized and are low valued are the main sources for the commercial production of surimi. In order to prevent wastage of lowly valued fish meat, utilization of the fish meat for longer duration is important and hence, further studies on this aspect are desirable.

When a fish is processed, each step has an effect on its microbiota. As a result, the microflora of the raw material can be significantly impacted by the environment in which it is gathered before harvest. Gram-negative cocci like Moraxella and Acinetobacter, as well as Gram-negative rods like Pseudomonas, Flavobacterium, and Vibrio, are the most common bacterial species found on fish at the time of capture (Liston 1980). Gram-positive cocci of the Micrococcus genus may prevail from time to time (Gillespie and Macrae 1975). On ice or in refrigeration, the genera Pseudomonas, Moraxella, and *Achromobacter* take over during storage of fish in ambient air (Gillespie and Macrae 1975; Lerke et al. 1965; Shewan et al. 1960). Trimethylamine (TMA), an odorous chemical linked with ruined fish and extensively researched as an indication of seafood spoilage, is produced in high levels by several *Pseudomonas* and *Achromobacter* species (Banwart 1979; Laycock and Regier 1971). Exposure of seafood species to sewage-contaminated water may result in contamination of the seafoods with pathogenic bacteria and viruses of fecal origin. Flatfishes caught near effluent discharge points in the Baltic Sea were found to contain Salmonella, a genus that causes a high percentage of foodbome illnesses (Wuthe and Findel 1972). Fish mayaiso contain spores of Type E Clostridium botulinum, One cold-tolerant type of this lethai toxin-producing bacterium. Another pathogenic bacterium that can grow at cold temperatures is *Aeromonas hydrophila*. This organism has been isolated from oysters and a variety of red meats (Abeyta et al. 1986; Okrend et al. 1987)

Thus in present investigation it is decided to study the effect of infection of significant spectrum of parasites on fresh, preserved and processed fish by evaluating variation in biochemical parameters and alterations in the immune boosting nutrients and also throwing some light on Surimi production. HACCP [Hazard Analysis and Critical Control Point] ensures that the end product food, ready for consumption is safe to eat. It is a seven step process for food safety as well as risk management and assessment plan. It is unique system that is intended to help reduce food safety issues, it's main focus is to prevent potential, physical, chemical as well as biological hazards that could be created when food is being manufactured.

3. Survey or review of literature and development in the relevant subject:

The first description of marine fish parasite from South Africa goes back to almost 200 years. It is therefore an opportune time to look back and take a stop in the history of discovery in the field of parasitology. Later various authors have reported presence of fish parasites, way back from 1950, Bhimachar and George 1952, Rao and Rao 1957, Venkatraman 1961, Luther 1973, Shivdas & Bhaskaran 2009and many others, however parasitic fauna was not studied in detail till almost 2010-11. R .Madhavi & T. Triveni Laxmi (2010-11) reported metazoan parasites. Graca Costa et al, 2011 studied

helminth parasites of Atlantic chub mackerel And Indaryanto 2014 & Indaryanto et al 2015 worked on *Rastrelliger brachizoma* (short Mackerel). R. Molina carried out parasitic survey in *R.brachizoma* 2020.

Good nutrition is essential to support strong immune system .Mackerel when it is at its peak season has upto 30% fat which enhances the flavors of fish and ensures that is packed with protein ,vitamin D& lots of healthy omega 3 fatty acids ,As published in Mackerel Academy Norway.Omega3 polyunsaturated fatty acid profile was studied by P. A. Aneesh et al in 2012. Thereafter, Bahurmiz 2017, Oko et al 2019, Burren smoke house 2020, Michael Joseph 2022 have thrown some light on the immunity boosting nutrients of Mackerel.

Surimi is a refined form of mechanically deboned fish meat that has unique functional characteristic including gel forming ability ,water and oil binding properties which makes it valuable ingredient in a broad range of food products – K.E Spencer & M.A Tung 1989.Surimi is useful for producing various kind of processed foods &surimi products imitate the texture and taste of a more expensive product using a relatively low cost material thus surimi is an inexpensive source of protein reported by many including Tyre Lanier 2016, Spencer & bligh 1987,Spencer et al 1988,Spencer et al 1990,Hongwei *et al* 2019.Surumi &Surimi based products –BurucuBozava 2019.The production of surimi & surimi sea food from tropical fish-a landscape view of the industry-report to the Certification and Rating Collaboration Dec 2020 Duncan Leadbitter, Pascal Guenneugues, Jae Park .Recent advances in Surumi Technology Jan 2002 Journal Fishery Science by Chang lee. Moraxella, Acinetobacter, Pseudomonas, Flavobacterium, and Vibrio, are the most common bacterial species found on fish at the time of capture (Liston 1980). Gram-positive cocci of the Micrococcus genus may prevail from time to time (Gillespie and Macrae 1975). On ice or in refrigeration, the genera Pseudomonas, Moraxella, and Achromobacter take over during storage of fish in ambient air (Gillespie and Macrae 1975; Lerke et al. 1965; Shewan et al. 1960).

4. Objectives of the research and proposed hypothesis: -

The objectives of the proposed study are as follows:

- To assess seasonal variations in parasitic fauna in Mackerel along the Mumbai coast.
- To analyse Histamine toxicity caused by Bacterial infection.
- To determine Biochemical parameters in fresh & processed fish meat.
- To evaluate Immunoboosting nutrients in fresh and processed fish meat.
- To appraise the importance of Surimi Technology.

5. Methodology to be used and adopted:

Mackerel will be collected from Mumbai coast (Versova,Andheri,Mahim creek and Sasoon dock (Colaba) & ferry wharf. Identification of fish will be made with the help of F. Day (1865-1889). 150 - 200 Mackerel ranging in size from 120mm to 240mm will be collected between June 2022 to June 2023 from above fish landing centers. Standard Methods will be followed for collection, fixation, identification of parasite. Diagrams will be drawn with the help of Camera lucida. Images for Photomicrographs will be taken by Microscope. Data on prevalence and mean intensity to infection will be recorded. Analysis of Biochemical parameters from Mackerel meat and Surimi product will be carried out by following standard and recognized procedures.

Study Area: - Mackerels will be collected from Costal line around Mumbai city and Mumbai suburbs of Maharashtra State.

6. Importance of study:

Mackerel is a popular fish resource affordable to common people all over India, throughout the year but little is known about each biochemical nutrient. The nutrients in mackerel play the important role in the optimal wellness of all the physical, mental function of body by boosting the immune system.

- **International Status-**

The increase in human population leading to shortage of animal protein sources all over the world directed the attention to fish as rapid and healthy source of good quality animal protein. Undernutrition causes major problems in developing and under developing countries like Pakistan, Shrilanka etc.

- **National Status –**

People belonging to below poverty line, uneducated and unaware eat different type of animal meat which has impact on their health. According to National family health survey of India many people are very lean or very fat because of unhealthy diet.

- **Regional Status –**

Mackerel fish have nutritional importance in view of their use in Surimi preparation. This sea food is abundantly available in coastal areas like Mumbai. The systematic study of these will be suggestive in developing techniques to reduce infections in them to retain & raise their nutritive value.

- **Scope of study-**

Incidence of parasitic infection in regularly used food items like Mackerel fish reduces their nutritional value. Intake of infected fish is a hygienic concern for humans. Hence systematic study of infestations in these fish species is important to understand their nature properly which will also help in designing control strategies for these infections.

7. Proposed work Plan with a Tentative chapter scheme:

The tentative division of the work to be done during this study into chapters is initially planned to be as following:

1. Introduction
2. Preface
3. Review of Literature
4. Geographical Background of Research Area
5. Materials and Methods
6. Result & Discussion
   - I) Taxonomy of Host and Parasites
   - II) Population Dynamics with seasonal occurrence
   - III) Histamine Toxicity
   - IV) Immunoboosting Nutrients
   - III) Biochemical Study
   - IV) Surimi Technology
7. Summary & Conclusion
8. Bibliography

8. Year wise Plan of work and targets to be achieved:

First Year:-Review of literature, Referencing, Research methodology, Visit to various fish landing centers in Mumbai. Collecting the Mackerels and preservation of parasites. Study of morphology of

parasites. Study of bacteria and effect of bacterial infection on the fish Mackerel and on the consumer. To carry out the study of HACCP process.

Second Year: -To study comparative Biochemical profile of the relevant nutrients in fresh fish meat and processed fish meat (surimi). To record and study data for wide range of spectrum of nutrients in Mackerel fish meat and processed meat, as well as to study about the immunoboosting nutrients.

Third Year: - To study the technique of surimi production by visiting various places in and around Mumbai, Ratnagiri etc.

Fourth Year: -Updating of Reference work, Thesis writing and paper publication.

9. Expected Outcome:

This study will throw light on impacts and their intensities of parasitic infection on various Parameters including Seasonal occurrence, Histamine Toxicity, Biochemical Parameter and Immuno-Boosting nutrients in host, Indian mackerel *Rastrelliger kanagurta* (Cuvier, 1816).

The major use of this will be in Designing control measures for parasitic infections in regularly consumed fish host, Indian mackerel *Rastrelliger kanagurta* (Cuvier, 1816) in Western Coastal Region of Country, which will have positive impact on Aquaculture economy.

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